NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, D.C. 20594

March 16, 2021

Rail Event Recorder

Specialist's Factual Report
By Charles Cates

1. EVENT SUMMARY

Location:	Upper Darby, Pennsylvania
Date:	August 22, 2017
Company:	SEPTA
Train ID/Locomotive:	Train Number 155
NTSB Number:	DCA17FR012
Summary:	Refer to the Accident Summary report, within this docket.

2. EVENT RECORDER GROUP

An event recorder group was not convened.

3. DETAILS OF RECORDER INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received an event recorder file from the following SEPTA train:

Locomotive ID: **SEPTA Train Number 155**

The file was titled 1552222.QEI and was downloaded from a Quantum Engineering model Q1082-N5 event recorder by SEPTA. This train was not originally fitted with an event recorder system, and the Quantum system was retrofit onto the car in 2005.

3.1. Locomotive Event Recorder Recording Description

The Quantum event recorder data from train number 155 were extracted using the Quantum Desktop Playback (QDP) software using the file's embedded wheel size, set at the time of download by SEPTA. The QDP software outputted the event recorder parameters including distance and speed. The exported data have a sampling rate of 1 Hertz (Hz), therefore the data has an accuracy of +/- 1 second.

The data provided in this report covers the 40 minutes leading up to the accident on a section of track from the Norristown Station to the 69th St. Station Transportation Center. Only the data relevant to this event are provided in this report.

3.2. Parameters

Table A-1 lists the parameters verified and provided in this report for SEPTA Train Number 155. Additionally, table A-2 contains the unit and discrete state abbreviations for the parameters. It should be noted that additional parameters are recorded by the Quantum event recorder system that were deemed to be not relevant to this event and they are not documented or included in this report.

3.2.1. Distance Traveled and Speed

The default output for the locomotive event recorder's total distance traveled started at 0 feet and the values were significantly large near the event. The number of feet traveled increases from 0 to 5,280 ft (one mile) and resets to zero to begin counting the next mile. Each time the number of feet resets to zero the number of miles increases by one.

Any error in wheel size measurement or entry at the time of download will be manifest as error in the speed and distance reported by the QDP software. The track chart reported distance from the Norristown Station to the 69th Street Transportation Center showed a total distance of 13.32 miles. The total distance recorded by the event recorder along the track was 13.29 miles, including 644 feet of reverse operation and an unknown distance due to wheel slip in both braking and acceleration. Because of these distance differences and uncertainties, an error band of +/-1.5% should be considered for speed and distance reported by the event recorder.

3.3. Event Recorder Timing

The recorded time from the SEPTA Train Number 155 event recorder data file is independently time stamped and, consequently, the times may not reflect the actual time of the day. Therefore, all times in this report and attachment are referenced as Recorder Time.

3.4. Plots and Corresponding Tabular Data

Figures 1 and 2 contain event recorder data from SEPTA Train Number 155 recorded during the event on August 22, 2017. All the parameters listed in table A-1 were plotted.

Figure 1 is a plot containing 40 minutes of data leading up to the accident and Figure 2 is a plot containing 5 minutes of data leading up to the accident. In brief, the event recorder data indicated the following:

- During the 40 minutes leading up to the accident, speed ranged from 0 to 56 mph and the Cab Overspeed Alarm signal was active 21 times during this period. In the final 5 minutes leading up to the accident the Cab Overspeed Alarm signal was active 5 times.

- The train was mostly moving in the Forward direction, but it moved in the Reverse direction on two occasions, once at 23:41:58 and again at 23:55:57.

- Wheel slip was recorded as being present intermittently during acceleration and deceleration events. During the three minutes leading up to the accident wheel slip became more prevalent, occurring during all acceleration and deceleration events.

- At 00:07:20, the train was traveling 11 mph with a cab signal of 15. Cab signal changed to 55 at 00:07:42 and the train began to accelerate. Nine seconds later the cab signal changed to 70 and the train continued to accelerate to 52 mph. Wheel slip was detected throughout the acceleration and continued as the train continued at speed.

- At 00:08:21, the cab signal reduced from 70 to 55. The train continued traveling at 48-53 mph. At 00:08:50 the cab signal reduced to 30 and the overspeed signal became active. At that time the speed was 53 mph. The Master Controller moved from the P3 setting to the B6 and then the B7 setting. The train continued traveling at 50-55 mph until the disc brakes on trucks A and B were activated at 00:09:04. The emergency push button signal also transitioned. The train began to decelerate at a rate of about 1 mph/sec with wheel slip detected.

- At 00:09:09 the cab signal reduced to 15 and the train was moving 47 mph. The train continued to decelerate at about 1 mph/sec with wheel slip detected. At 00:09:29 cab signal changed from 15 to No Aspect. At 00:09:38 with speed at 19 mph, speed rapidly dropped to 0 mph, consistent with an impact.

All of the corresponding tabular data used to create figures 1 and 2 are provided in electronic separated value (.csv) format as attachment 1 to this factual report.

Figure 1: SEPTA Train 155 event recorder parameters (40 minutes).

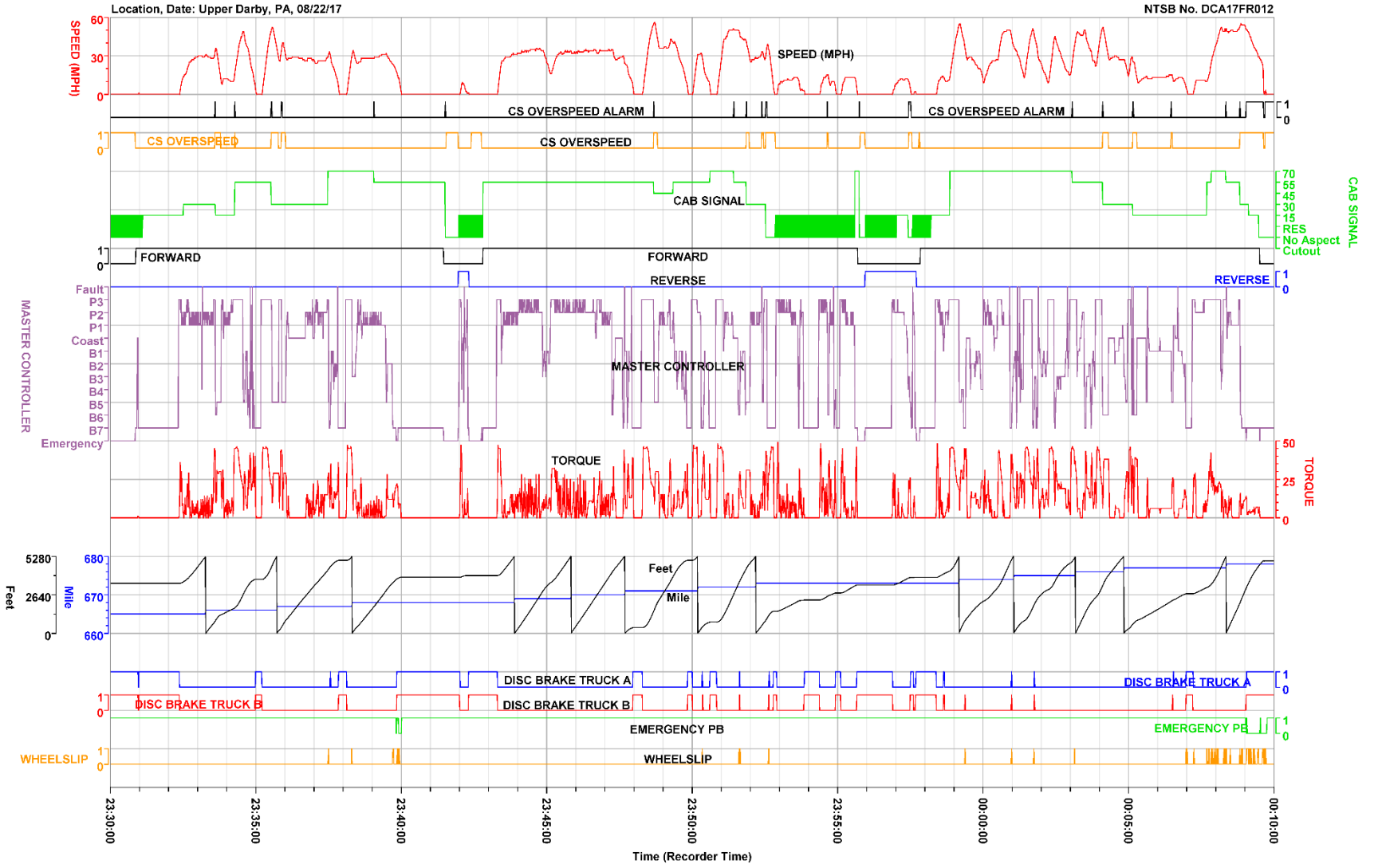
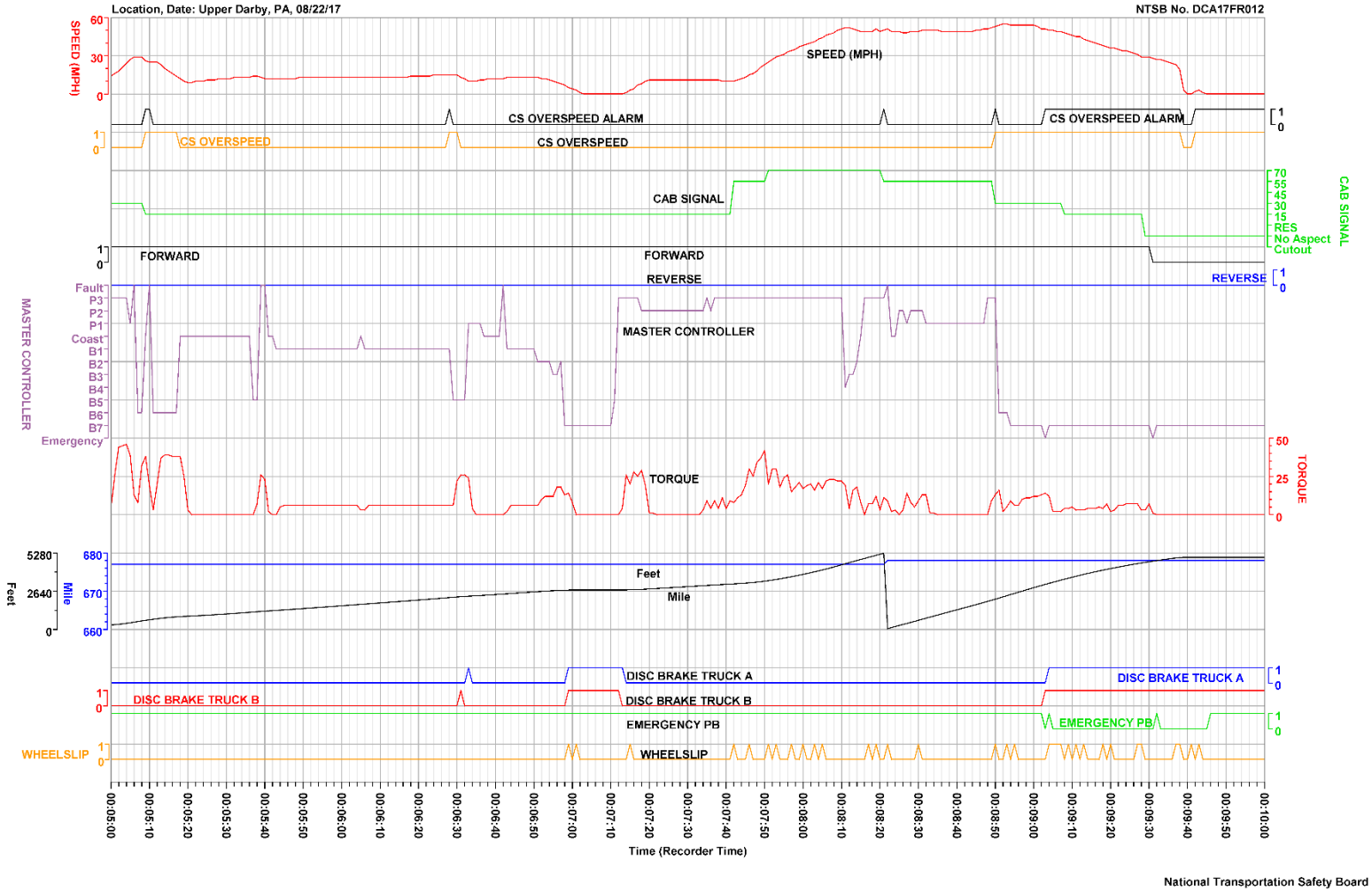


Figure 2: SEPTA Train 155 event recorder parameters (5 minutes).



APPENDIX A

This appendix describes the event recorder parameters provided and verified in this report for SEPTA Train 155. Table A-1 lists the plot labels, parameter descriptions, and units. Table A-2 contains the unit and discrete state abbreviations for the parameters.

Table A-1. Verified and provided locomotive event recorder parameters for SEPTA Train 155.

Plot Label (units)	Parameter Description
1. Cab Signal	Cab Signal
2. CS Overspeed	Cab Signal Overspeed
3. CS Overspeed Alarm	Cab Signal Overspeed Audible Alarm
4. Disc Brake Truck A	Truck A Disc Brakes Applied
5. Disc Brake Truck B	Truck B Disc Brakes Applied
6. Emergency PB	Emergency Push Button Activated
7. Feet (ft)	Feet traveled
8. Forward	Direction selected Forward
9. Master Controller (state)	Train Control Position
10. Mile (mi)	Miles traveled
11. Reverse	Direction selected Reverse
12. Speed (mph)	Speed
13. Time (HH:MM:SS)	Recorder Time
14. Torque (%)	Motor Torque
15. Wheel Slip	Wheel Slip Detected

NOTE: Parameters with a blank unit description in table A-1 are discretes. A discrete is typically a 1-bit parameter that is either a 0 state or a 1 state where each state is uniquely defined for each parameter.

APPENDIX A

Table A-2. Unit and discrete state abbreviations.

Unit and Discrete Abbreviation	Description
B1	Braking Level 1
B2	Braking Level 2
B3	Braking Level 3
B4	Braking Level 4
B5	Braking Level 5
B6	Braking Level 6
B7	Braking Level 7
Coast	Coast Power Level
EMG	Emergency
FAULT	Master Controller fault
ft	feet
mi	miles
mph	miles per hour
P1	Power Level 1
P2	Power Level 2
P3	Power Level 3
P4	Power Level 4